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ROL' PERVICHNOY PRODUKTSII V RESHENII PROBLEMY  
GIDROBIOLOGICHESKIKH PROTSESSOV I PUTEY UPRAVLENIYA IMI

(The Role of Primary Production in Solving Problems of  
Hydrobiological Processes and the Means of Controlling Them)

by

V. I. Zhadin

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ABSTRACT

The paper discusses the effect of primary production and biological contamination of water basins, which causes pollution of water and fouling on vessels, water pipes and hydraulic structures. The problems arising from the phenomena and the measures aimed at lessening or eliminating their negative effect on national economy and sanitary conditions are singled out, indicating the need for special organizations and institutes that would contribute to the solution of the complex problems.

The Translator

Author: V. I. Zhadin

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THE ROLE OF PRIMARY PRODUCTION IN SOLVING PROBLEMS OF  
HYDROBIOLOGICAL PROCESSES AND THE MEANS OF CONTROLLING THEM

(A Scientific Committee of the Academy of Sciences USSR, known as  
the "Hydrobiological Processes and the Means of Controlling Them")

The Academy of Sciences of USSR has adopted a new system of coordinating scientific investigations--namely, the scientific soviets on the leading scientific problems. One of the problems of the Department of Biological Sciences of the Academy of Sciences USSR is considered the "Hydrobiological Processes and the Means of Controlling Them."

The substance of the problem, its content, task and objectives are discussed in a brochure issued at the end of 1959 in the series of "Problems of Soviet Science," published by the Academy of Sciences of USSR.

"Inasmuch as in all the water basins--it is stated in the brochure--as for instance in oceans, seas, rivers, lakes, water reservoirs, and canals, occur complex biological processes, whose significance is either positive or negative for the national economy, transportation and building, the science devoted to biological processes in water basins--namely, hydrobiology--has a very important task: 1) to disclose the laws of the circulation of matter and the biological productivity in various types of water basins; 2) to attain on the basis of the discovered laws, by utilizing the earlier and later achievements of science, the maximum increase in the effect of biological self-purification in water basins and the introduction of methods of biological purification of stagnant waters contaminated with organic and mineral substances which settle on the structures of cleaning establishments; 3) to develop effective methods for the prevention of fouling, biological corrosion and other biological interferences occurring in seas and fresh-water basins and committing great harm to the use of vessels, hydrotechnical structures and water pipes."

This statement discloses that hydrobiology is required to solve important theoretical and practical problems. However, it need be pointed out in defense that the problems of fisheries that are solved from the hydrobiological point of view are associated with another problem of the Academy of Science, which is coordinated by the Bureau of Ichthyological Committee--namely, "the Regularities of Dynamics of the Quantity, Behavior and Distribution of Fishes, Sea Mammals, Commercial Invertebrates and Algae in Connection with Conditions of their Existence."

It is obvious that close contact and cooperation must be established among the hydrobiologists engaged in both of the problems. Moreover, the data of investigations pertaining to one or the other problem need be utilized in the practical aspects of the entire national economy. A number of Soviet hydrobiologists are successfully engaged in both of the problems.

A correct selection of investigational methods must play a great role in obtaining results in a scientific work dealing with the problem of hydrobiological processes and the means of controlling them. Therefore, a number of methodical questions are associated with the problem, such as: 1) a comparative methodical study of the processes of primary biological production in various types of water basins in various geographical locations (a comparison of the results of studying the photosynthesis of phytoplankton by the radio-carbon, oxygen, chlorophyll and the weight-calculation methods, the study of bacterial chemosynthesis in the water and bottom of a basin); 2) the role of microorganisms in the circulation of matter and the biological productivity (with the application of the latest methods); 3) the hydrological and hydrochemical factors of biological processes in water basins (with the development of new methods of study).

In connection with the tasks arising from the problem of hydrobiological processes and the means of controlling them, the content of the brochure is divided into three sections: 1) the laws of circulation of the matter and the biological productivity of water basins; 2) the biological self-purification of water basins and the protection of water from contamination; 3) biological interferences in the utilization of hydro-technical structures, water supply, shipping, port structures and measures of fighting against the interferences.

There is no institute in the Soviet Union, either in the system of the Academy of Sciences or among the offices of institutes, which would correspond to the profile of problems concerning the hydrobiological processes. Individual aspects of the problem are studied at the present time by various institutes: the Zoological Institute of the Academy of Sciences USSR, the Biological Institute of Water Basins, the Institute of Oceanology, the Sevastopol' Biological Station, the faculties of invertebrate zoology and hydrobiology of the Moscow and Belorussian state universities, the Institute of General and Communal Hygiene of AMN SSSR and other sanitary institutes. The VODGEO Institute (former Central Committee on Water Conservation) has changed to a considerable degree the type of its work. The functions of water basin conservation are now executed by the State Sanitary Inspection.

In connection with the fragmentation of themes of the problem among institutes subjected to various agencies and the absence of a unified complex of the hydrobiological institute, the Scientific Soviet is expected to play a great role in the coordination and direction of the work on the problem, which has been confirmed by the Bureau of a Section of Biological Sciences of the AS USSR.

During the brief time of its existence the Scientific Soviet has conducted a difficult task in the preparation, confirmation and issuance of notes on the problem containing, in addition to its declarative part, concrete suggestions of work for the coming seven years. During 1959 the Scientific Soviet has concluded a business contract with a number of large production concerns: one of the meetings took place in the laboratory of the Moscow Water Supply System and was devoted to problems of drinking water supply; another one occurred at the Kuybyshev Biological Station together with the leading workers and engineers of the V. I. Lenin Volga GES, and they discussed measures to be taken against the fouling of hydraulic structures by the mollusk Dreissena; at the third meeting, on the basis of a request by the Don Basin Water Trust, the problem of water pollution in the Severnyy Donets-Donbass Canal, affected by biological factors, was discussed. The problems associated with the study of hydrobiological processes that affect the interests of national economy are scheduled for discussion. Lastly, the conference on the primary production represents to a degree the outcome of the activity of the Scientific Soviet on the problem of hydrobiological processes; the conference was organized in consultation with the Soviet by G. G. Vinberg, a member of the Scientific Soviet.

Taking advantage of the fact that responsible persons in the field of studying the primary production of water basins had gathered, I elucidated the role played by the primary producers and the processes of primary productivity in a number of branches of national economy.

I shall point out here the great positive significance of primary production of water basins in the fishing trade with the cultivation of water birds, when (in the second case) even such a product as Elodea (water thyme) appears to become a positive factor. Great is the significance of the processes of primary biological production when refining the stagnant waters flowing into natural water basins. The significance is still greater in ponds established for biological cleaning and small-scale structures made for the cleaning purposes. It should be pointed out that the primary producers are utilized not only for the cleaning of stagnant waters containing polluting organic matter, but also for the cleaning of water polluted by various mineral compounds, including radio-active materials. It is worthwhile to remember the interesting suggestion by A. V. Frantsev to utilize the higher plants for the elimination of excess organic matter from water basins.

During the last years, the problem on direct utilization of primary producers--the algae--by man has been widely discussed. In a number of institutes, a large-scale cultivation of Chlorella has been established on a year-round basis.

Also the negative role of primary producers and processes of primary productivity need to be mentioned. Even in the fishing industry an excess production of phytoplankton, algae and higher plants has a negative effect. Moreover, some of the measures, whose control is difficult if used for the improvement of fishing water basins, may lead to extremely negative results due to excess development of plant life. In a number of cases, the primary production becomes a hindrance for the water supply, navigation, the utilization of hydrotechnical and water supply establishments.

In addition to the well-known fact of the water-bloom creating considerable difficulties in the use of water basins and ponds as sources for the water supply, another factor made its appearance--namely, the development of filamentous algae in canals, used for water supply. For the first time, the negative effect of this factor was noted in supplying water from the Uchinskiy Water Basin to the Stalin Water Supply Station. The Uchinskiy Water Basin, representing a purifying establishment, keeps more than half of the organic substances that enter here from the Moscow Channel. During the time a small canal, supplying water from the basin to the water supply station, becomes a place where the quality of water is sharply reduced as a result of mass development of algae on the walls of the canal. With a view to eliminating this biological contamination, A. V. Frantsev suggested a number of measures, notably a mechanical purification of the concrete slopes of the canal.

Another case of the contamination of drinking water is observed in the Severnyy Donets-Donbass Canal. This canal, more than 100 km long, must supply water for the towns of the Don River Basin instead of the water coming from numerous small water basins where the water-bloom is a real scourge. In the newly established canal, as a result of certain circumstances, a slow water movement is created and on the slopes of the canal a great number of algae, mainly Cladophora, develop. The algae are torn off by the water, float and jam the water pipes in their enclosures, but in autumn they rot, and the water becomes unsuitable for drinking. How to sanitize the canal--is a problem placed before us by the Don Basin Water Trust. Regrettably, we are not in a position to give an exhaustive reply to this question for the time being: such types of canals have not yet been investigated, whereas the mechanical measures against algae are difficult to apply here because the slopes of the canal are made of rock debris.

Analagous problems of biological contamination of water supply arise in connection with the planning of the Oka-Moscow, Dnepr-Krivorog and Karaganda canals.

Since long ago, another type of biological contamination--in the form of the mass development of higher water and swamp plants--has been in existence in the canals of the irrigation system of Central Asia and other arid areas. A very illustrative example of such a type is the Southern Karakum Canal. The water basins of this canal are so overgrown with macrophytes that the water evaporates from them most intensely in the process of transpiration. Moreover, when a need arises for the letting through of large quantities of water, the masses of plants form a dam and the water above the basin overflows its banks.

It will be possible to mention many other examples of biological contamination resulting from mass development of the primary producers on the hulls of ships, on the walls of port structures, inside various types of pipes and water conduits. However, enough has been said in order to realize the importance of problems confronting the hydrobiologists when studying the processes of primary production.

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